Holocene Evolution on the Septentrional Catalan Shelf

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The septentrional sector of the catalan continental shelf is characterized by an irregular width, and narrow and deeply incised submarine canyons (Cape Creus and La Fonera) (Stanley et al.,1976). The shelf is narrow (6-19 km) in front of onland structural highs (Pyrenaic Axial Zone and Bagur Massif), showing a rocky and abrupt coast line; while is wide (17-30 km) in front of the onland Neogene depressions (Bajo and Alto Ampurdán), where Fluvia, Muga, and Ter rivers develop deltas, and longitudinal beaches are predominant. The shelf break is gentle and is located around 150 m waterdepth. Dominant oceanographic processes are waves from storms generated in the nearby Gulf of Lyon, a N-S general current regime, and a clockwise geostrophic flow in the Gulf of Rosas.

The sedimentological analysis of surficial samples reveals three types of sediments: a) terrigenous gravels and coarse-to-medium sands (-2.80 Ø - 1.25 Ø mean) on the abrupt coasts, and medium-to-fine terrigenous sands (1.21 - 2.57 Ø mean) on the longitudinal beaches; b) finnig-offshore muds with a terrigenous sand fraction, on inner and middle shelf prodelta areas (4 Ø - 9 Ø mean), and on the north sector (5 Ø-7 Ø mean); and c) coarsening northwards palimsest sediments (7 Ø - 3 Ø mean) on the outer shelf, having a mainly terrigenous sand fraction, with bioclastic components (35-45%).

The core (up to 1.5 m long) stratigraphy suggests two main types of transgressive sequences (Fig. 1). 1) coarsening-, and fining-upward sequences in the prodelta areas, well correllated with the high-resolution seismic facies (Díaz and Ercilla, 1989). These sequences represent muddy deposits with thin intercalations of sandier horizons whose number and thickness decreases toward the distal prodelta, where only mud is found. 2) fining-upward transgressive sequences, offshore the prodelta areas. These transgressive sequences show an erosional basal contact and are composed (from bottom to top) of: shell fragments and other bioclastic (bryozoans, serpulids crusts) on a muddy matrix and fining upwards sands, sometimes grading to shelf muds.

Sedimentary processes, that have dominated on the septentrional catalan shelf during the Holocene, record the interaction of terrigenous input from several river sources and the local oceanographic conditions. The sedimentary processes are responsible for the present surficial sediment distribution: Holocene sediments on the inner and middle shelf, and palimsest sediments (Pleistocene deposits mixed with the modern sediments) on the outer shelf. The main active sedimentary processes are: 1) longshore drift and offshore downwelling bottom flows, that distribute the coarse sediments in a narrow sand belt parallel to the coastline; 2) advection of fine-grained river-carried sediment, that is distributed by the general current regime, forming the prodeltas across the inner and middle shelf; 3) resuspension of fines by storm waves and gravity-induced processes and their deposition offshore the prodeltas areas; and 4) escape of fine-grained sediment from the Gulf of Lyon, that mainly contributes to the muddy covering on the northern shelf sector.

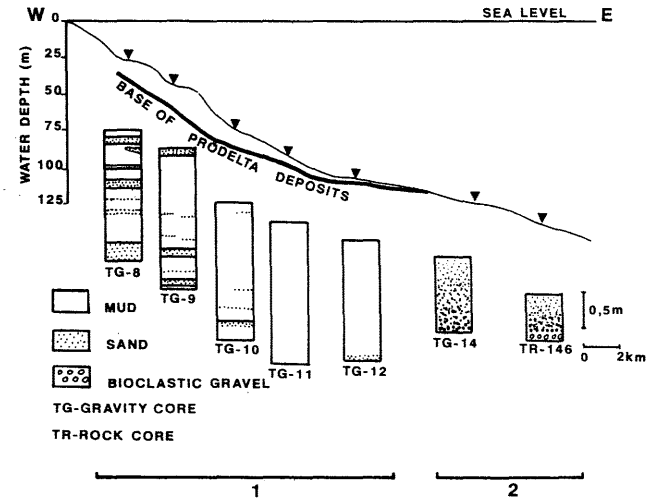

Figure 1.- Types of transgressive sequences on the septentrional catalan shelf: 1) coarsening-, and fining-upward sequences in prodelta areas, and 2) fining-upward transgressive sequences, offshore the prodelta areas.

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Relative Sea-Level Oscillations and Depositional Patterns on the Ebro Distal Continental Margin : Plio-Quaternary Evolution

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The Plio-Quaternary deposits of the Ebro distal margin are developed over a major boundary, Reflector M of Messinian age. This reflector was eroded when most of the margin was subaerealy exposed due to the sea level drops of the Messinian salinity crisis. The sedimentary sequences, above Reflector M, define four major environments (shelf, slope, base-of-slope, basin floor) corresponding to several systems tracts related to major sea level oscillations. Lowstand and highstand systems tracts are differentiated on the basis of reflectors characteristics, unit geometry and interpreted depositional environment. Information from piston cores samples and boreholes from the oil industry and DSDP Site 122 complement the identification of depositional units, and allow for a time framework to correlate with global eustatic sea level oscillations (Ryan, Hsü et al., 1973; Garcia-Siñeriz et al., 1979; Alonso and Maldonado, 1990; Dañobeitia et al., 1990).

Lowstand systems tracts are characterized basinward by shelf margin deltas near the shelf edge, thick slope muds on the slope, and channel-levee complexes, base-of-slope aprons and interchannel deposits at the base-of-slope region. These deposits, accounting for most of the stratigraphic thickness of the Quaternary sequence show a stratigraphic continuity of seismic reflectors between these two provinces that may represent a contemporary deposition (Fig. 1). The most active growth periods of the distal margin occurred during intervals characterized by relative sea-level falls, similarly to siliciclastic turbidite deposits throughout the geological record. Slope deposits are largely related with shelf-edge spillover and distal prodelta high density flows on the upper slope, with gravity-driven nepheloid flows on the middle slope, and with turbidite and mass-flows on the lower slope (Baraza, 1989). The base-of-slope deposits were also developed during these periods of low-sea stands and they are associated with two styles of deposition: (1) flushing of sediments from river discharge, outer shelf and upper slope environments trough slope canyons, to base of slope channel-levee complexes, and (2) with unchannelized mass flow processes, from slope mass-failure in areas of unstable slope terrain resulting in the base-of-slope aprons (Alonso and Maldonado, 1990). The highstand systems tracts are characterized at the slope and base of slope by volumetrically less important stratified facies developed by hemipelagic processes over most the distal margin, although some transparent, high energy facies of the base-of-slope aprons may also occurs. These deposits were developed during the latest rising segment of the eustatic curve, high sea level stand and initial sea lowering (Fig. 1).

We can identify four epochs in the growth patterns of the distal Ebro margin during the Plio-Quaternary (Fig. 1): (A) during the "salinity crisis" the emergence of the Ebro margin allows the carving of extensive erosional surfaces and the by-passing of sediments to the distal basin plain; (B) the Pliocene flooding of the Mediterranean Sea after the Messinian time, and generalized global eustatic high sea level favoured the development of depositional units characterized by shallow marine facies in the fluvial valleys and a drape of fine-grained deposits (Ebro Clays) over most of the continental margin, corresponding to a highstand systems tract (C) the generalized lowering of sea-level of the Late-Pliocene displaced the sediment supply from Ebro River to the distal margin, developing a new drainage system with canyons and channels above the lower sequence, and initiates a lowstand systems tract; and (D) the subsequent eustatic-climatic oscillations of the Late Pliocene-Quaternary time have controlled the deposition of sequences represented by slope wedges, channel-levee complexes and base of slope aprons, alternating with low energy, sediment drape units that represent respectively low and highstand systems tracts.

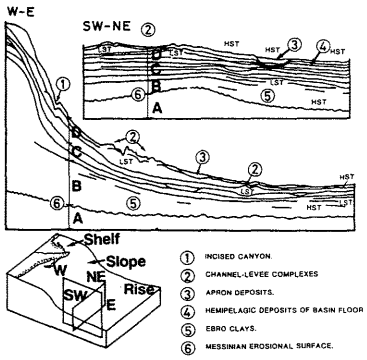

Figure 1. Lowstand (LST) and highstand (HST) systems tracts and four epochs (A,B,C,D) in the growth patterns of Ebro distal continental margin.

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